

3. Solubility - Solubility of a substance is its maximum amount that can be dissolved in a specified amount of solvent at a specified temperature. It depends upon the nature of solute and solvent as well as temperature and pressure.

3.1

Solubility of a solid in a liquid - Polar solutes dissolve in polar solvents and non-polar solutes in non-polar solvents. So, a solute dissolves in a solvent if the intermolecular interactions are similar. i.e. like dissolves like.

- a) When a solid solute is added to the solvent, some solute dissolves and its concentration increases in solution. This process is known as dissolution.
- b) Some solute particles in solution collide with the solid solute particles and get separated out of solution. This process is known as crystallisation.
- c) When the two processes occur at the same rate, no. of solute particles going into solution will be equal to the solute particles separating out and a state of dynamic equilibrium is reached.
$$\text{Solute} + \text{Solvent} \rightleftharpoons \text{Solution}$$

In this stage, the concentration of solute in solution will remain constant under the given conditions (temperature and pressure). Similar process is followed when gases are dissolved in liquid solvents.

- d) In a solution in which no more solute can be dissolved ~~is~~ at the same temperature and pressure is called a saturated solution.
- e) Unsaturated solution is one which more solute can be dissolved at same temperature.

3.1.1. Factors affecting solubility of solute -

a) Nature of substance - Like dissolves like.

Solubility of ionic solids differ in their solubility in water by two factors -

1) Lattice energy - Energy required to break & separate the ions present in 1 mole of the solid.

2) Hydration energy - Energy released because of hydration of 1 mole ions of the solid.

∴ Ionic solids with high lattice energy are less soluble in water as compared to those with small lattice energy.

In case of Hydration Energy, solids with greater value of hydration energy are more soluble in water as compared to solids with lesser hydration energy value.

b) Temperature - Crystalline solids dissolve in water with absorption of heat. Ex: NaCl, KCl, KNO_3 , $NaNO_3$ etc. The heat energy absorbed is used to separate ions from solute before they dissolve in solvent.



According to Le-Chatelier's principle, as the temperature is raised, the heat energy absorbed will favour the forward or dissolution process. Thus, solubility will increase with rise in temperature.

→ Some salts like lithium carbonate, Cerium sulphate, Sodium carbonate monohydrate ($Na_2CO_3 \cdot H_2O$) dissolve in water with evolution of heat. In this case

The rise in temperature will favour process according to Le-Chatelier's principle and the solubility will decrease.

Thus, in nearly saturated solution, the dissolution process is endothermic ($\Delta_{sol} H < 0$) the solubility should increase with rise in temperature and if it is exothermic ($\Delta_{sol} H > 0$) - the solubility should decrease.

c) Pressure - Pressure does not have any effect since solids and liquids are highly incompressible and practically remain unaffected by changes in pressure.